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U. S. DEPARTMENT OF AGRICULTURE,
OFFICE OF EXPERIMENT STATIONS,
A. C. TRUE, Director.

ANNUAL REPORT OF THE HAWAII AGRICULTURAL EXPERIMENT STATION FOR 1901.

BY

JARED G. SMITH,
Special Agent in Charge.

[Reprint from Annual Report of the Office of Experiment Stations for the year ended June 30, 1901.]

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By Jared G. Smith, *Special Agent in Charge.*

INTRODUCTION.

The establishment of the present agricultural experiment station in the Hawaiian Islands had its inception in the appropriation made by the Fifty-sixth Congress, first session, when the sum of $10,000 was granted to enable the Secretary of Agriculture to investigate the field and establish an experiment station in Hawaii as has been done elsewhere. In pursuance of the act of Congress, Dr. W. C. Stubbs, director of the Louisiana Agricultural Experiment Stations, was sent to Hawaii during the summer of 1900, and the results of his inquiry are given in a report transmitted to Congress in January, 1901, and published as House Doc. 368 (Fifty-sixth Congress, second session), and afterwards as Bulletin 95 of the Office of Experiment Stations of the U. S. Department of Agriculture. Dr. Stubbs was instructed to investigate the agricultural conditions of the islands, with special reference to the organization and work of an experiment station. It was recommended by him that the station to be established should be under the control of the Secretary of Agriculture and independent of local institutions. A station for the study of all matters pertaining to the sugar industry has been maintained for a number of years by the Hawaiian Sugar Planters' Association, and as it will continue to prosecute its work upon problems relating to the sugar industry it was believed best that the station to be established under the auspices of the Department of Agriculture should devote its energies chiefly to other agricultural interests. Among the subjects to which it was suggested the station should give its attention are the culture of fruits, vegetables, rice, forage crops, coffee growing, stock raising, dairying, irrigation, and forestry.

After conferring with the local authorities, the tract known as Kewalo-uka, adjoining the city of Honolulu, was recommended as a site for the station. (Pl. XXV.) This tract had been set aside by former officials for experimental investigations in agriculture and forestry. An examination of the records of the former Hawaiian Government showed that while there was a very evident intention to reserve this land for experimental purposes, the necessary formalities were never fully carried out. Subsequently 20 acres was reserved by Presidential proclamation as a site for a hospital for the Navy Department, and 7 acres for the same purpose for the Marine-Hospital Service under the Treasury Department.

Acting upon the suggestions made in the preliminary report, Congress appropriated $12,000 for continuing the work during the current fiscal year, and immediate measures were taken to establish and equip a station in accordance with the above recommendations. Accordingly the writer was transferred to the Office of Experiment Stations from the Section of Seed and Plant Introduction of the Department of Agriculture, and was charged with the responsibility of beginning the work of organization of the Hawaii Agricultural Experiment Station. In carrying out my instructions I left Washington, D. C., March 21, 1901, arriving in Honolulu on April 5, and at once began active operations to carry out the desires of the honorable Secretary of Agriculture as I understood them.

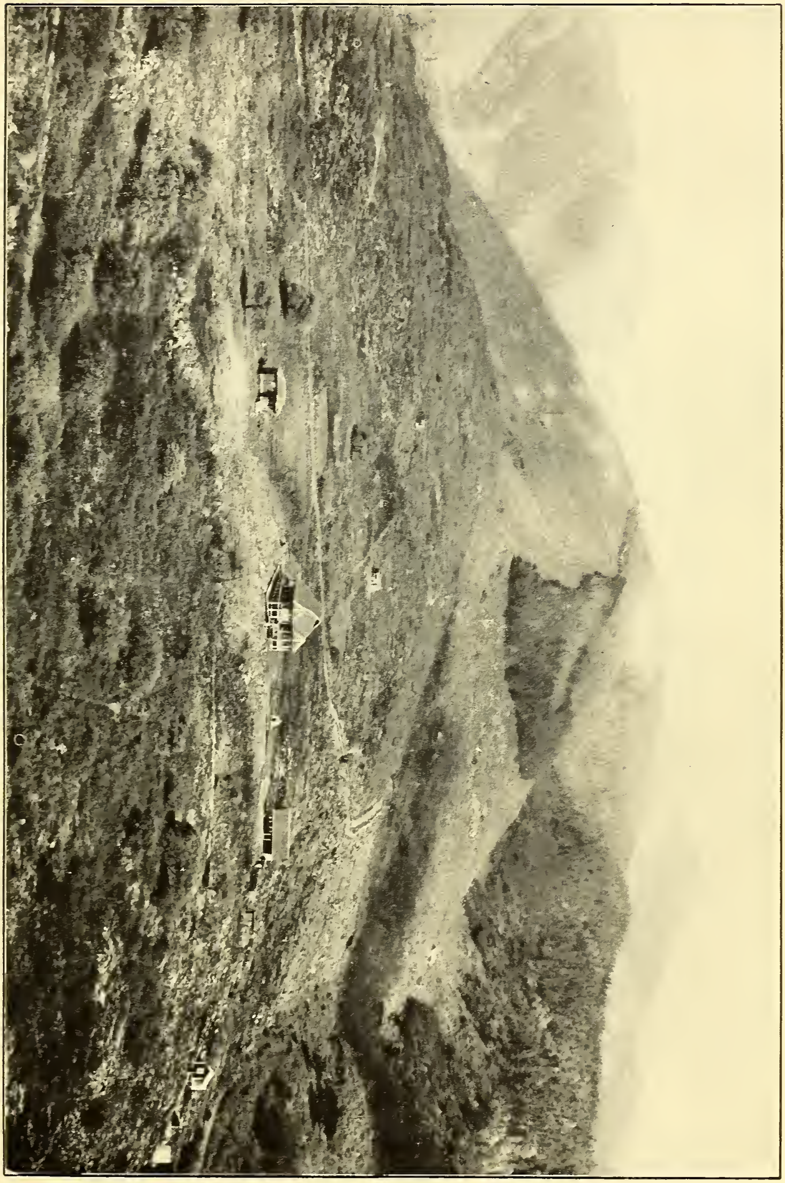
A temporary office was secured in the Territorial capital building and was fitted up with desks, office furniture, bookcases, etc.

DETAILED REPORT OF WORK.

The period from April 5 to May 15 was occupied in making preliminary surveys of the land which had been set apart for the use of the station, the Kewalo-uka tract in Makiki Valley, adjacent to the city of Honolulu. This tract, containing 154 acres, lying along the southeast slope of the Punchbowl and Tantalus ridge, is nearly 2 miles long and has a maximum width of about 300 yards at its lowest portion, nearest the city, and about 100 yards at the upper end. The elevation ranges from 125 feet, nearest the city, to 1,350 feet on the end nearest Mount Tantalus, the height of that peak being 2,013 feet.

Although the preliminary arrangements had been entered into in September, 1900, between the governor of the Territory and Dr. Stubbs, yet the formal transfer did not take place until June 10, 1901, when two tracts were reserved to the Territory, one of 10 acres as a stone quarry and a second of 52 acres on the slopes and within the crater of Punchbowl Hill, which was reserved for a public park. By the courtesy of the Secretary of the Navy this Department was granted the temporary use of the naval hospital site for experimental purposes. The work of clearing land and erecting buildings was begun with as little delay as possible. Twenty-four acres, comprising all of the Naval Hospital Reservation and land adjacent to it, was cleared of a dense growth of guava and lantana bushes, prickly pear, and algaroba or mesquite bean woods. (Pl. XXVI, fig. 1.) The contract under which the work was performed called for the removal of all tree stumps and roots and plowing the land to the depth of 20 inches. This work was

PLATE XXV.



HAWAII STATION SITE.

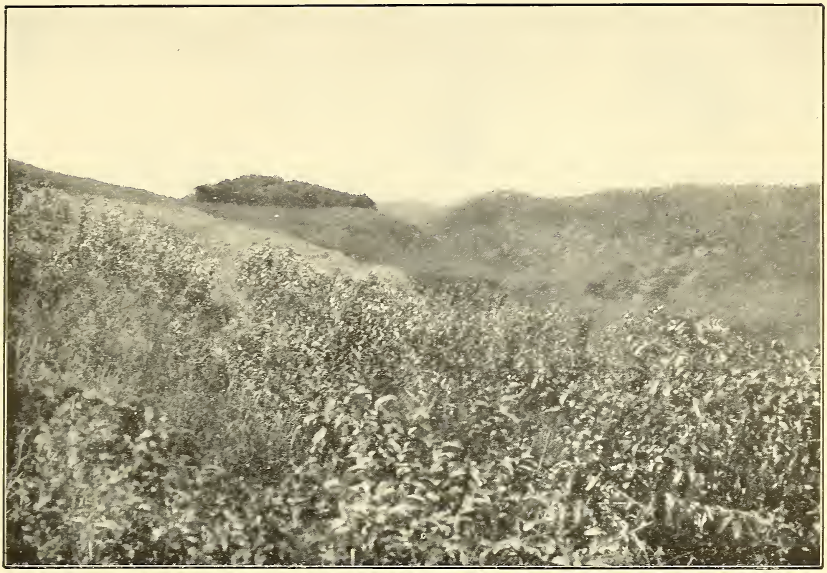


FIG. 1.—HAWAII STATION—VIEW OF STATION SITE BEFORE BEGINNING CLEARING.

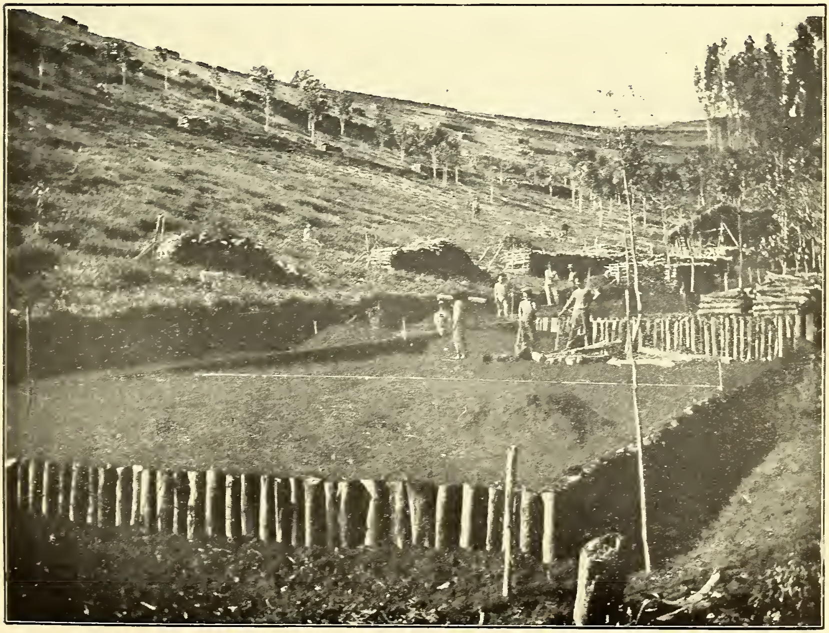


FIG. 2.—HAWAII STATION—BUILDING TERRACES ON UPPER PART OF STATION FARM.

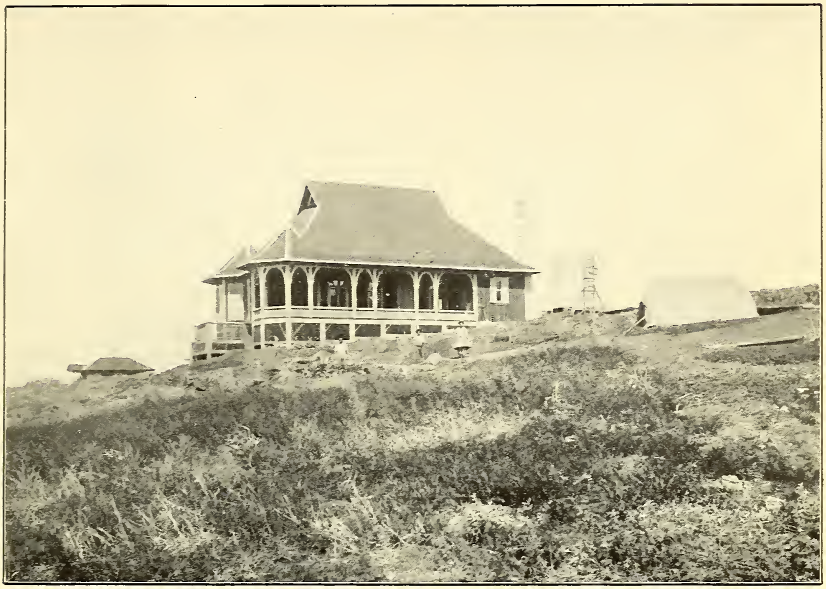


FIG. 1.—HAWAII STATION—DIRECTOR'S RESIDENCE.

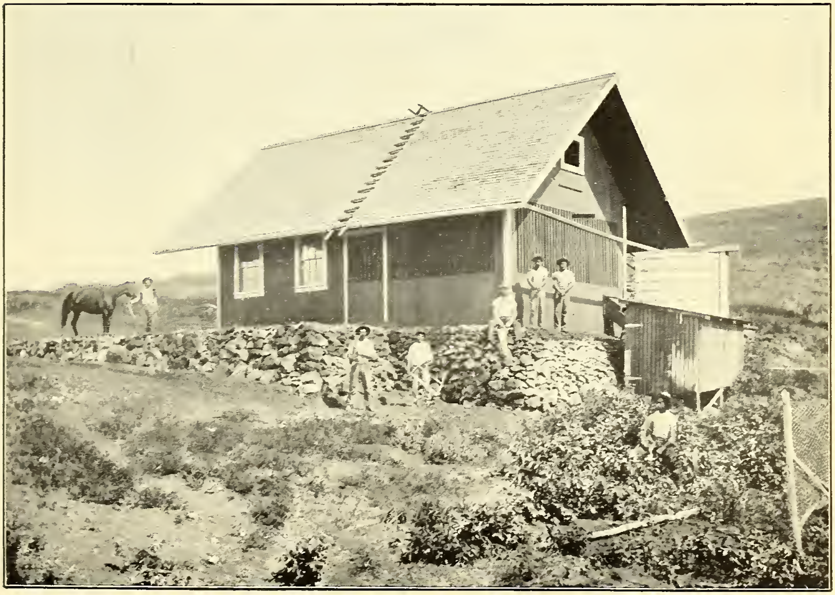


FIG. 2.—HAWAII STATION—STABLE.

not completed within the period agreed upon, but was carried out in an extremely careful manner, reflecting great credit upon the contractor. The cost of this work amounted to $30 per acre. About 30 cords of wood, worth $10 a cord, were obtained from this land and are now on hand subject to sale.

Thirteen acres of 15-year-old planted eucalyptus or Australian gum forest was also cleared at the upper end of the tract at a contract price of $65 per acre. (Pl. XXVI, fig 2). The trees were very dense in this forest, and the cost of removal of roots and stumps much greater than in the open algaroba and guava woods at the lower elevation. This contract was carried out by Japanese labor and was not as efficiently performed as the previous one, given to an American firm. About 400 cords of wood were secured by the station, valued at $3 to $3.50 per cord.

Contracts were also let for the erection of an office and a residence building. The office contains two rooms, and is intended to be only one wing of a building, the remainder to be completed at a later date. The residence contains six rooms. Both office and residence occupy a commanding position on the heights above and back of Honolulu, at an elevation of 350 feet above sea level. These buildings cost $3,900, the contract not including the painting. (Pl. XXVII, fig. 1.)

A 2-story stable, 18 by 32 feet, with three stalls, carriage room, tool and harness rooms, was planned and built by the special agent in charge. In connection with the stable are a 2,000-gallon tank, watering trough, and manure shed, and there are feed bins and chutes at convenient location. (Pl. XXVII, fig. 2.)

A 2-room hut or cottage was also built to serve as quarters for the laborers employed. A poultry house and poultry yard inclosed by wire netting has been built; also a small house in which to store dynamite, considerable amounts of which have been used in blasting and grading operations necessary in grading and making roads around the station buildings.

A seed bed was prepared and covered over with slats in lieu of a glass or canvas covered propagating house.

The location of the station buildings having been made above the level to which city water is at present supplied, a water system had to be installed by the station. A line of 1-inch pipe was laid 900 feet to connect with the city water system, and a 10,000-gallon tank was placed at an elevation of 250 feet, that being the maximum height above sea level at which city water is now supplied. Another 10,000-gallon tank was erected back of the residence, at a height above the floor line to give enough water pressure in both office and residence.

A 1½-horsepower gasoline engine and double-acting pump were installed at the 260-foot level, and the water is pumped through a 2-inch galvanized iron pipe into the upper tank. A 4-inch swing check valve was placed between the pump and the upper tank to relieve the engine from the longitudinal vibration resulting from the alternating rise and fall of the 2-inch column of water in the discharge pipe. The working pressure is about 47 pounds. All outside water connections, including the installation of the pumping plant, were made by station employees and not by contract; this having proved the only satisfactory way of getting work done, and at the same time the cheapest.

A dark room for photographic work and the storage of chemicals has been built in one of the office rooms, and a water-closet is also being added. About 200 feet of board walks have been laid. All station buildings have been painted at least one coat by workmen employed direct by the station, this having been found to be the cheapest and most satisfactory method for all work. A garden has been prepared by trenching the soil and adding lime. About 20 acres on the slope above the station buildings had been roughly cleared of guava and lantana to allow the grass to grow up for pasturage. Tools required for the large force of laborers employed have been purchased from time to time, so that there is now on hand a very satisfactory supply, including the ordinary farm, blacksmith, and carpenter's articles. A blacksmith shop is planned and will shortly be erected, so that repairs and breakages may be attended to without delay and at little cost.

A fire plug with 50 feet of fire hose has been connected with the main discharge pipe from the pump to give needed fire protection. Other connections will be installed at each of the principal buildings. The large tank has been connected with the one beside the stable, and this in turn with a smaller one at the laborers' quarters, and connections have been made where easy of access in the garden for irrigation, on a moderate scale.

On the upper clearing where the blue-gum forest was cut away, about 1½ acres have been dug over and terraced, using some of the cord wood for buttress work. Here also a two-room hut has been erected for laborers' quarters, at an elevation of about 1,075 feet. This cottage has a corrugated galvanized-iron roof, made with a 4-foot overhang, the idea being to collect as much rainfall as possible. Besides the two living rooms there is a large supply and tool room. The water from the room is stored in a 3,000-gallon tank; pipes are laid from this so that the water can be used on the terraces. A 2,000-gallon tank and lumber for the construction of a small stable are now on the ground and will be put up some time this winter. These buildings were considered necessary because of the elevation above the main station buildings. The upper clearing is more than a mile from the office by the most direct route, along a narrow and steep bridle trail, or fully 4 miles by the winding Tantalus wagon road.

This comprises in brief the constructive work on the Hawaii Experiment Station for the period from April 5 to November 1, 1901, seven months.

The correspondence has been rather large, the station having already given assistance and information to many farmers in all the islands of the group.

Some poultry experiments have also been inaugurated. These could be undertaken immediately without great expense, and it is hoped that they may lead to results of immediate practical usefulness. Largely because of the great number of diseases with which barnyard fowls are afflicted in the Hawaiian Islands the supply of poultry does not meet the demand. Live chickens sell in Honolulu markets for $15 a dozen and eggs at from 40 to 50 cents a dozen. If the station can demonstrate a practical way for the economical production of chickens and eggs it will add largely to the resources of the small farmers on the islands. The ravages of the disease known as sore head are so severe as to almost prevent the raising of domestic fowls. An article on Chickens and their diseases in Hawaii has been prepared by my assistant, Mr. T. F. Sedgwick, and published as Bulletin No. 1 of the Hawaii Station. This treats of sore head, as well as of several other common diseases, and gives simple precautions and preventive measures which, if adopted by poultry growers, will do much toward enabling farmers to fight disease.

As soon as possible, experiments will be begun in animal husbandry and dairying. Owing largely to an insufficiency of forage, meats are very expensive. In the markets of Honolulu hogs sell for from 10 to 17 cents per pound live weight. To remedy this difficulty it is intended to undertake at an early day feeding experiments with various roots and tubers and with the common papaya as food for swine.

As soon as possible, experiments in dairying should be undertaken upon a carefully planned system. Dairying and cattle feeding are now being carried on on a small scale with some measure of success, but the supply of milk and butter is insufficient to meet the demands of the home trade. Island butter retails for 60 cents per pound, milk for 12 cents a quart, and Hawaiian-made cheese is almost unknown in the Hawaiian markets. A few of the dairies are managed on a scientific basis.

There is, moreover, widespread ignorance of the best combinations of feeds and too great dependence on one-sided rations both in feeding dairy cattle and in fattening animals for the shambles. The use and necessity of leguminous forage plants are not recognized. Enough by-products of the sugar plantations are burned every year to feed all the beef, pork, and mutton consumed in the islands.

Experiments should be conducted in the utilization of the waste cane tops in the form of silage for feeding dairy cattle and beef steers, and with the waste molasses for fattening sheep, cattle, and hogs. On some plantations the work horses and mules are fed cane tops and molasses to good advantage. The practice can be extended to other branches of animal husbandry with profit. But it is of even greater importance that extensive experiments be carried on with forage plants rich in protein, the clovers and beans, to supplement and fully utilize the heat and fat-making constituents of the cane top and sorghum rations generally used. The Hawaiian Islands can grow and fatten more than enough animals to supply the home demand. At present, considerable importations of cattle, beef, mutton, hogs, and pork are made from the mainland, Australia, and New Zealand. Because of the location of the group, Hawaii ought to be able to command a superior market for all her surplus dairy and meat products in the Orient.

HORTICULTURAL INVESTIGATIONS.

Plans are being made for experiments in horticulture, including both fruits and vegetables, and coffee culture. These will include experiments with reference to the methods and times of pruning, methods of cultivation, picking, and marketing, as well as tests of varieties.

The Hawaiian Islands market depends largely on supplies of fruits from the mainland at all seasons of the year. Not only can enough fruit in sufficient variety be grown to supply the local markets, but both fruit and vegetables might be grown for export. The Honolulu market is usually well supplied with fruits and vegetables, though not always of the best quality nor in large variety, but the plantations, farms, and ranches depend largely on canned products. Work to show the practicability of the growing of a wide range of fruits and vegetables for the home table at a distance from well filled markets will be profitable and desirable.

It is hoped that experiments in coffee culture and the growing of various spices and drugs may also be undertaken at an early day.

COFFEE IN HAWAII.

Probably $10,000,000 has been sunk in unprofitable coffee cultivation in these islands during the last ten years. An intelligent investigation of all phases of the coffee industry will well repay. Coffee is a white man's crop. It is grown at elevations unsuited to cane and where the climate is admirably adapted to a comfortable and healthful existence.

The coffee lands of Hawaii can be made as productive as any in the world. Experiments in the selection and crossing of varieties to produce more prolific or hardier trees, and especially an investigation of the methods of curing coffee, should be made in an effort to save this industry. Hawaiian coffee has already made for itself an enviable reputation for quality and flavor of berry. If it could be sold on its merits instead of in competition with the low-grade coffees of Brazil and Central America, it would in time prove an immensely profitable crop. An effort should be made to save this industry from total extinction. It is a crop especially suited to the small farmer and the small investor—the man who can build up a home and care for his crop himself. The establishment of the coffee industry on a successful basis would make the Hawaiian Islands a land of small farmers more quickly than the transformation could be accomplished in any other way or through the medium of any other crop or industry.

The exports of coffee from the Territory of Hawaii during the fiscal year ended June 30, 1901, amounted to upward of 2,600,000 pounds, valued at $311,000. The production of 1901 has been greater than that for any preceding year. This increase in yield and amount exported is in spite of unprecedentedly low prices for coffee and a general overstocking of the markets of the world. The downward trend of the prices of all grades of coffee since 1895 has brought ruin to hundreds of small planters in the Hawaiian Islands. Only those continue in the industry who have sufficient capital to tide over years of depression, or who are content to market their product at or below the bare cost of production. Those of the former class are very few in number; those of the latter comprise the hundreds of Portuguese, Hawaiian, and Japanese landowners, homesteaders, and renters having 5, 10, 20, or sometimes 40 acres of bearing trees. In most of the coffee districts on the islands the owners of the larger tracts of bearing coffee have ceased to cultivate their plantations and are spending no money on the harvesting of the crop, allowing the berries to dry on the trees or rot on the ground, unless they are able to make contracts with Japanese or Portuguese to harvest the crop on shares, and in that case are content with one-fifth to one-half of the crop, the Japanese or Portuguese laborer receiving the balance in payment for his services.

The islands on which there are now bearing plantations of coffee are, in the order of their importance, Hawaii, Maui, Kauai, and Oahu.

On Hawaii, where the largest areas are planted, the chief producing districts are, in the order of their importance, Kona, Olaa, and Hamakua, while Kau, Hilo, Puna, and Waimea add their quota to the whole.

A preliminary survey has been made of the Hamakua, Olaa, and Puna districts of Hawaii, all lying on the windward, or west coast of the island. Even a most hurried glance at these few districts can not fail to impress upon the visitor the fact that the island of Hawaii is the home of coffee. Whether the plant is given the most scientific and careful cultivation, or through stress of circumstances the plantation has become overgrown with fern and weed and is totally uncared for, the trees throughout show a thrift and a freedom from disease which augurs well for the success of this crop whenever market conditions or a rise in prices again permit the rehabilitation of the industry. Even under the most adverse conditions of shallow, sterile soils, excessive rainfall, and acid or poisonous subsoils the yield per tree and per acre is often surprisingly large. On the Horner plantation, Kukaiau, 400 trees yielded 1,500 pounds of coffee at their first crop. On both the Horner and Louisson plantations in Hamakua, individual trees have yielded from 5 to 7 pounds of coffee—not simply selected trees at wide intervals, but whole fields. As judged by results in pounds of coffee per acre, the Hamakua district is absolutely ideal for this crop, and this district alone can challenge the world with the quality of its product. The berries are borne (on the Guatemalan variety) from 20 to 30 in a cluster, and the clusters are so thick along the branches that one wonders how any more berries could possibly be borne on any part of the plant, unless they were underground on the root. (Pl. XXVIII, fig. 1.)

The coffee lands of Hamakua overlap the cane lands. Mr. J. M. Horner, the pioneer in this industry, states that the area suited to coffee in Hamakua comprises a belt 35 miles long and 3 miles wide, and from 500 to 3,000 feet elevation. It reaches from about 2 miles on the Hilo side of the Maulua gulch to the Kohala plain. The bulk of this 67,200 acres is still government land, and if such conditions should arise as would permit an extension of the coffee industry in Hawaii nearly all of this area could be utilized. At a fair average yield of one-half ton per acre, the arable portion of this stretch of fertile forest land could be made to produce from 25,000,000 to 30,000,000 pounds of coffee per annum. Hamakua coffee was awarded the highest premium at the Omaha Exposition, in competition with coffee from all over the world—from Java, Brazil, Central America, Arabia, and various South American countries.

The typical Hamakua coffee soil is a mellow forest loam, deep and well drained yet retentive of moisture, easily worked, and quickly responding to fertilization and good cultivation. The district is distinguished from those bordering it by an absence of running streams. The abundant rainfall (about 100 inches per annum) sinks into the porous soil and is readily conserved by deep tillage. It was a matter of comment that the crops grown on these typical coffee soils exhibited a remarkable resistance to drought during the dry season of 1901.

At the time of the height of the coffee industry in Hawaii, in 1897, 1898, and 1899, upward of 6,000 acres were planted to this crop in the Olaa district. There were about 1,500 families of small settlers and homsteaders in the Puna, Hilo and Olaa districts, all more or less dependent on the future of coffee. Now, December, 1901, there are not to exceed 250 families. Of the 200 white settlers in Olaa alone, only some 25 now remain, and most of these depend on other money crops

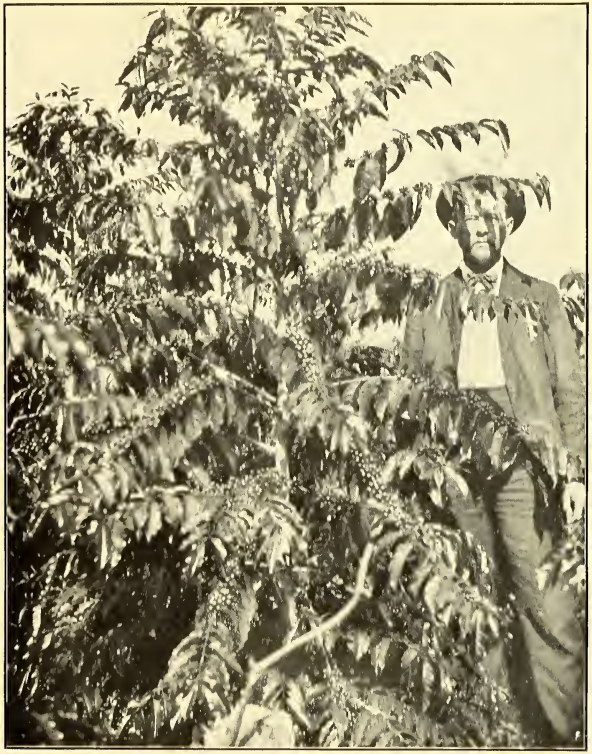


FIG. 1.—HAWAII STATION—THREE-YEAR-OLD HORNER'S GUATEMALA COFFEE.

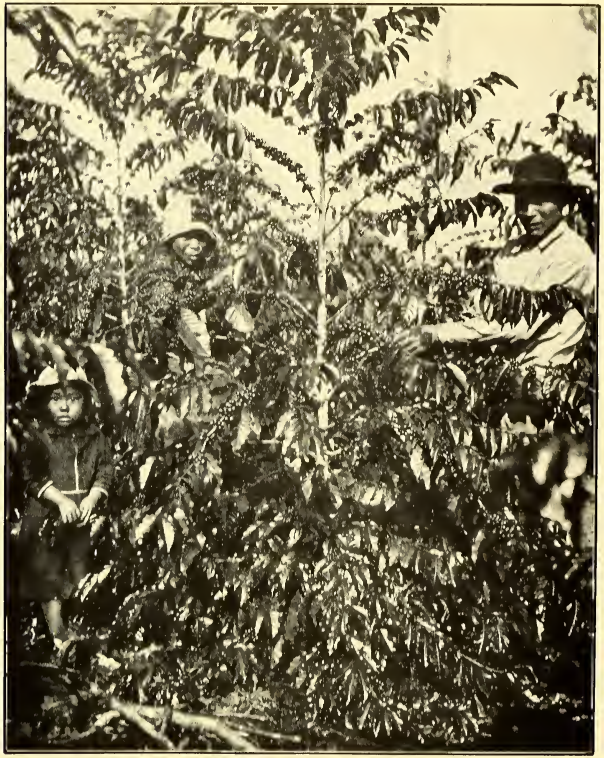


FIG. 2.—HAWAII STATION—JAPANESE PICKING COFFEE.

than coffee. A typical 100-acre farm formerly in coffee now consists of 20 acres cane. 15 coffee. 15 orange. 2 lemon, 4 bananas, 1 pineapples, 1 bamboo, 4 forage crops, 2 pasture, 6 experimental garden, 4 prepared for planting bananas, and the balance forest and the lands surrounding the home buildings. Most of the Olaa and almost all of the Hilo and Puna coffee orchards have been pulled up and cane planted in their stead, or have been simply deserted by their owners. Deserted homes characterize the formerly prosperous Olaa colony. The loss of capital in this one district amounts to over $2,000,000 in the last five years.

The cause of the failure of the coffee industry in Hawaii has been primarily the abnormally low prices of coffee, due to overproduction in coffee-growing countries all over the world. Annexation made the sugar planters wealthy because Hawaiian sugar was at once admitted duty free. It also brought ruin to the coffee planters because it placed Hawaiian coffee in competition with the South and Central American duty-free coffee, whereas there had been up to the time of annexation a duty on foreign coffees imported into Hawaii. It reaches its optimum development at elevations of from 1,300 to 2,500 feet above sea level, and in this Territory that belt is, on all the islands, one where the climatic conditions are ideal. If coffee can be restored by Congress to the same status which it enjoyed previous to American control, Hawaii and Porto Rico can produce within ten years all of the amount consumed by the United States. A duty of from 2½ to 5 cents per pound on coffee would do more toward making Hawaii a land of prosperous homesteads and prosperous people than any other legislative measure which could be taken. The coffee lands lie above the cane lands and the development of the coffee industry will thus not interfere with cane growing. But in case sugar should even go down to such a point that its cultivation would prove unprofitable, at least a portion of the cane lands in some portions of the islands would be capable of profitable conversion into coffee. There has been enough experience in coffee growing in these islands to develop a distinctly Hawaiian system of cultivation and treatment. The mistakes made by new men in a new land with a new and untried crop, such, for instance, as that of using Ceylon methods in Olaa, have been costly, but such work will not have to be done over again. There are still many men who believe in the future of coffee in Hawaii. These are maintaining their plantations at least possible cost, but with a view to deriving at least a living from the land. The low prices for the crop have weeded out all except these who were conducting the business on an economical basis.

There are, at a low estimate, 200,000 acres of coffee lands on the four islands, Oahu, Maui, Kauai, and Hawaii, most of it still virgin forest. And there is another 100,000 acres and more which would not fall within the belt of optimum conditions, but where coffee could undoubtedly be grown. The limit of production would be near 100,000 tons, and this yield could be reached without converting to the purpose one single acre of land on which sugar cane is now grown. If Congress will afford to coffee the same protection which is extended to sugar, it would mean not only the building up of an industry among our own people and within our own borders, but the establishment of this industry on a firm basis would also mean a marked increase in the number of small landowners. From the national standpoint, that State which produces or can produce within its own borders the greatest number of necessaries consumed by its own people is the strongest. To foster the coffee industry in these islands of the Pacific will be to make Hawaii a stronger member of the family of States.

I append herewith some correspondence which may throw more light on the subject. I believe from what I know of the islands that Mr. Wight's views are correct and unprejudiced. They are certainly worthy of consideration.

HONOLULU, H. I., *May 16, 1901.*

DEAR SIR: In conversation with Mr. A. Louisson he stated that you were desirous of obtaining authentic information in regard to the cultivation of coffee and other crops adapted to these latitudes, and, having gone into this matter most thoroughly, I take pleasure in placing such information as I have at your disposal.

LOCATION AND PREPARATION OF PLANTATIONS.

Experience has demonstrated that coffee can be successfully cultivated only at an elevation of over 1,000 feet, and the best results are obtained at an altitude in the neighborhood of 2,000 feet. A deep rich soil is essential, and also a certain amount of shade. The lands in the Hamakua district above the cane belts from Kukuihaele to Laupahoehoe grow fine coffee; from Laupahoehoe into Hilo results have not been satisfactory. This is probably due to a clayey subsoil. The upper lands in the district of Kona are also suited to the cultivation of coffee. A rainfall of from 50 to 100 inches a year, evenly distributed, is essential to produce the best grades. Absence from wind is also requisite.

The first step in opening a coffee plantation is the erection of laborers' quarters. Fifteen dollars an acre will cover this expense, including suitable water containers. The next step is clearing the land. The best practice is to cut down the forest, cutting the trunks of trees over 1 foot in diameter in lengths of 8 feet, and below 1 foot in diameter in lengths of 12 feet. All brush smaller than one's wrist is best burned, but great care should be taken in burning the brush not to burn over the land. The ferns which are invariably found in forest land keep the ground moist, prevent weeds from growing, and also protect the young coffee trees against insects, and the growth of the ferns does not interfere with the growth of the coffee.

There is no doubt but that coffee grows better in the shade than in the open, the amount of shade depending on the rainfall and altitude of the plantation. In the Hamakua district 12 shade trees to the acre give the best results. Coffee trees grown in the open throw out branches close together, necessitating much extra labor for pruning; those grown in too dense shade throw out branches too far apart and the crop does not ripen well, but by placing shade trees judiciously the coffee grows sufficiently open to make the labor of pruning nominal.

PREPARING LAND FOR PLANTING.

After a forest is felled and cut into lengths, the timber should be placed in rows from 8 to 10 feet apart; holes to be dug in the space thus cleared for the young coffee trees. The best distance to space the rows is still a matter of discussion. Eight or nine feet is the most common practice.

PLANTING AND CULTIVATION.

This is a most important process, and should be done only by men who have been carefully taught this work. A peculiarity of the coffee tree is that if the taproot be not planted straight the tree will not flourish, and replanting is inevitable.

VARIETIES.

The best results have been obtained from seed known as Horner Guatemala. The origin of this seed is obscure. The variety is identical with the best grade of Java coffee. I have imported the best varieties of Java, but the Horner seed produces a coffee in every way equal to the Java in appearance, while the flavor is superior. Both the Java and the Horner coffees give trees which send out branches straight from the trunk. The Hawaiian coffee droops, and in consequence pruning and picking from the Hawaiian trees are more expensive. The quality is also inferior to either of the above varieties.

In planting coffee a great many "sports" are found, and there is no doubt that, under judicious experimental cultivation improved varieties would be discovered.

After the plantation is started, the care required for the first year is very slight. In the Hamakua district, in forest land, one man can easily look after 15 acres, the work consisting in weeding and replanting. Ten per cent is a fair estimate for replanting.

Estimates as to what cultivation ought to cost are of very little value. With the most careful management, and without making any mistakes, it costs $200 to clear an acre of land and maintain it until the trees are four years old, when the first crop is taken off.

COST OF PICKING AND MAINTENANCE.

Having never cultivated coffee over four years old, the cost of keeping up a plantation after this time is unknown to me, but it should not exceed $3 per acre per month exclusive of picking and interest on the investment.

The cost of picking, I know from experience, will amount to between 5 and 10 cents per pound of market coffee, 7½ cents per pound being a fair average. (Pl. XXVIII, fig. 2.)

Cleaning, drying, and transportation will amount to about 3 cents per pound more. In other words, figuring an acre of coffee ready to bear at $200, it costs 12 cents to produce 1 pound of marketable coffee laid down in Honolulu.

Our coffee is divided into several grades. The best brings about 13 cents; the poorer grades, about 9 cents per pound, the above figures representing a crop whose average value is 12 cents per pound. In the figures given as to the cost of bringing an acre of coffee into bearing the cost of superintendence has not been taken into consideration. A man cultivating his own crop would make this item nominal, whereas an expensive manager on a small plantation would make this cost greater than all others. On a well-managed plantation of 100 acres, a fair estimate for the manager's time, and the cost of a residence, would increase the price per acre $100, making the total cost of 4-year-old coffee $300 per acre.

Rainfall has a very decided bearing on the selling price of coffee. Where the rainfall is regular throughout the year a large berry of regular shape is produced; where the rainfall is spasmodic the berry is small and irregular in shape. A large regularshaped berry will bring from 1 to 2 cents per pound more than a small misshaped berry, although the cup qualties of the coffees are precisely the same.

The selection of a location for a coffee plantation is a most important consideration, and a newcomer should under no circumstances decide this matter without the advice of a successful cultivator.

Being thoroughly familiar with the island of Hawaii from Kohala to Kau, I can say the land of Hamakua, immediately back of the Hamakua and Paauhau sugar plantations, lying at an elevation of from 1,500 to 3,000 feet, offers the best natural advantages of any district; and should you contemplate establishing an experimental station for the cultivation of coffee, I would suggest that you select a location in the Hamakua district.

PRESENT STATUS OF THE INDUSTRY.

With the most favorable locations and with the best management, coffee can not be produced for less than 12 cents for the average value of entire crop laid down in Honolulu, and this grade will bring an average of 13 cents in San Francisco. Inasmuch as coffee is sold on sixty days' credit, and from three to four months are consumed in selling a crop, the present San Francisco price is barely equal to the cost of production, and unless the industry is encouraged by a protective tariff in the immediate future the entire business so far as the production of the better grades is concerned will be stamped out.

Considerable areas throughout the islands of uncultivated coffee will be picked in a desultory way by Japanese and Hawaiians. The flavor of this grade is very inferior, and the method of curing is crude, and in consequence these coffees are bringing to-day in the San Francisco market from 8 to 10 cents per pound, and a certain irregular production of this grade will be continued under any circumstances.

The cultivation of coffee is one of the most interesting of agricultural pursuits. Mr. J. M. Horner, who is largely engaged in sugar and coffee, once told the writer that when he was thoroughly tired out in the sugar fields, work in the coffee brought back health, strength, and courage.

The altitude at which coffee thrives is best adapted for the production of food crops—corn, potatoes, and garden vegetables can be grown most successfully in connection with coffee, and by the cultivation of forage crops a fine grade of butter and beef can be produced; poultry also flourishes.

The coffee industry of the islands has gone from bad to worse. The situation to-day is such that the market prices of our coffees are below the cost of production, and while a few of the plantations may struggle along for a year or two longer, unless speedy relief be furnished the end is inevitable.

The point where the most favorable location and careful management will enable a coffee plantation to live has been passed, and if you will trouble yourself to inquire at the banks you will find that it is absolutely impossible to obtain a loan on a coffee plantation beyond the bare value of the land, and even then the banks are reluctant to make advances.

Up to the time that we were annexed to the United States the Hawaiian duty on coffee protected our market to the exclusion of all other coffees, but since that time low-grade coffees have been introduced from the United States, and in consequence the Honolulu market has been materially affected. I am not in a position to give statistics, but I believe that at least one-third of the Hawaiian trade in coffee is supplied from abroad, and a representative of a large wholesale house in San Francisco told me that his sales of coffee in these islands were largely increasing.

Referring to your inquiry as to the amount of lands available in the islands for the cultivation of coffee, I am not able to give you any approximately correct information for the reason that certain localities which appear to have every natural advantage will not grow coffee when the actual test is made, and that other localities which present a very unfavorable appearance give very fine results. But I should estimate that on all of the islands there is in the neighborhood of half a million acres which could be utilized, either wholly in the production of coffee or of coffee in combination with other crops.

J. F. Brown, commissioner of public lands, in 1898 estimated that there were 76,270 acres of Government land suitable for coffee, and there must be at least five times this amount of land held by corporations and individuals. In making this estimate I have taken into consideration only lands above the cane belt—say those lying at altitudes of from 1,000 to 5,000 feet.

Immediate relief to the present situation could be afforded if the United States Government would give our coffees preference in supplying the needs of the Army and Navy, and I would suggest that it might be advisable to bring this fact before the Department of Agriculture at Washington.

MISCELLANEOUS CROPS.

Corn, potatoes, sweet potatoes, cabbage, lettuce, turnips, beets, and Portuguese onions can be fairly successfully cultivated, the one drawback being the cutworm. I have seen a quart of cutworms dug out of a surface 6 feet square, and it is needless to say that under such conditions nothing can be cultivated.

All of our Hawaiian lands produce natural forage crops when the forest is first cleared, viz, honohono (*Opelismenus compositus*) and pualele (*Sonchus oleraceus*), but after the land has been cropped for a certain length of time these plants can not be depended upon, and sorghum, bunch grass, or alfalfa should be planted.

Good dairy stock can be purchased from ranchers, although the price is very high. Cows give as much milk as in California, but it is not as rich nor is the butter as sweet and waxy as that of California. Beef, butter, and hogs command ready sale at high prices at all times, and the possibility of maintaining a dairy exclusively on cultivated forage crops is well worthy of your attention.

Speaking in a general way, after a family has been located six months on a coffee plantation, the living expenses of that family should not exceed $15 per month, provided the cutworm problem can be solved.

The agricultural possibilities of these islands are untried, but the first step in developing the lands of higher altitudes should be the placing of some staple adapted to this section on a firm basis, and this can best be done with coffee. Coffee should become one of the staples of these islands. But unless it be protected to the same extent as rice and sugar, it is folly for anyone to consider the cultivation of this crop.

Neither corn, potatoes, nor garden vegetables can be profitably cultivated to any great extent owing to the lack of a market. The only regular source of demand is the city of Honolulu, and as the white population are the only consumers of European vegetables, this demand is limited; consequently any supply over that required by a population of 10,000 can not be consumed and an extensive production of vegetables is bound to end in failure through lack of a consuming market.

What is known as the Kula district on Maui is used exclusively for the cultivation of corn and potatoes, and although the area cultivated does not exceed 1,000 acres, at times crops have been allowed to rot in the fields owing to the prices having become so low that it did not pay to gather them.

Mr. R. H. Long, who has raised vegetables successfully in Petaluma for the San Francisco market, has undertaken the cultivation of cabbage, tomatoes, cauliflower, celery, beets, turnips, and other garden truck, in the districts of Weimea, Hawaii, and while he has met a number of reverses through cutworms and heavy storms, he is still sanguine as to the ultimate success, but he expects to supply all the markets on these islands from a farm of 100 acres.

In my opinion the fruits of the Temperate Zone can not be profitably cultivated to any extent owing to the small consuming population of the same. A considerable market for oranges ought to be found here and a plantation of 400 or 500 acres should succeed, but I doubt if any considerable foreign market could be found. On the other hand, coffee, gutta-percha, India rubber, cocoa, cacao, cocoanuts, and products which are naturally adapted to this latitude, which will keep indefinitely, and which are used universally all over the world, seem to me more desirable crops.

Yours, very truly, C. S. Wight.

Mr. Jared G. Smith,
Commissioner of the Department of Agriculture,
Honolulu, Island of Oahu, Hawaii Ter.

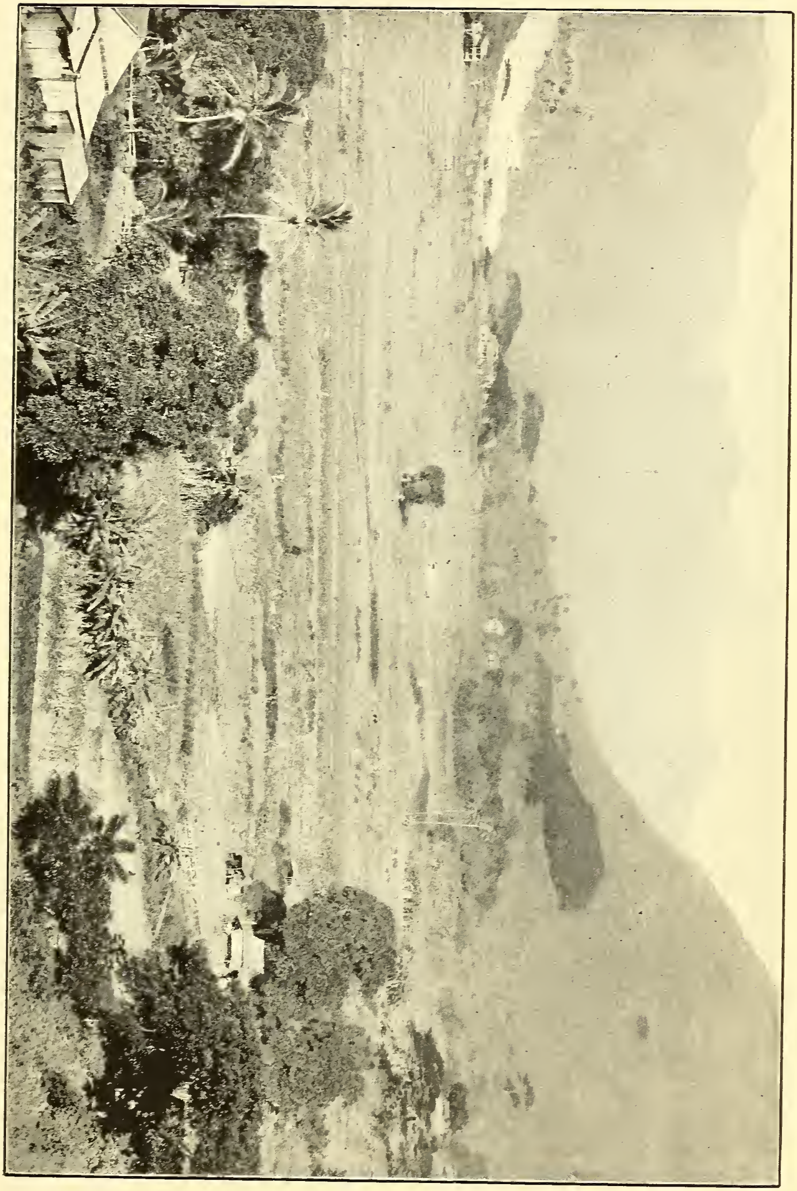
At my request my assistant, Mr. T. F. Sedgwick, has prepared brief statements upon the present condition of a number of important industries, which I submit herewith. It is shown that of such important food crops as potatoes and rice not enough are grown to supply the local demands, and of taro, which is one of the important plants, being used both as bread and as a vegetable, the supply is gradually diminishing, owing to a number of causes.

A cooperative experiment in taro growing was started with Judge Wilcox of Honolulu about August 15. A taro patch was selected in which almost every plant was affected with "blight," and experiments are now being made to find methods by which the disease can be checked. Losses in the yield of taro have in some cases amounted to 90 per cent of the crop. Taro being the staple food of the native Hawaiians, these experiments, if successful, will be of great and immediate practical value. (Pl. XXIX.)

POTATOES.

Formerly potato growing was an important industry, potatoes standing at the head of the list of exports. In 1849 the number of barrels exported was 51,957, but at the present time the local demand is almost wholly supplied by importations, which amount to 1,500,000 to 2,000,000 pounds per annum. The retail price varies from 1½ to 4 cents per pound.

It is estimated that there are at least 6,000 acres of land well adapted to the growing of potatoes. The best potato land is in the Kula district, island of Maui, on the slopes of Haleakala, the yield varying from 1½ to 4 tons per acre. The soil is fine, almost a powder, quite deep, and does not crack. The tubers are smooth and free from pimples and present a good appearance in the market. The size of the potato is inferior, but this is due to poor selection and bad cultivation, as there are records of specimen potatoes 16 inches long and 11 inches in circumference. The quality is excellent, and when properly shipped brings a good price in the market. Good potato land is also found in the vicinity of Kawaihae, island of Hawaii.



Hawaii Station—Rice and Taro in Panoa Valley.

Of late years the industry has diminished to a fraction of the home consumption. Most of the potatoes now raised are grown by Japanese, but even they are becoming discouraged owing to the ravages of disease and the use of poor seed. The black rot of the potato has appeared, last year's crop being practically destroyed. This year there are a few struggling patches under the care of Japanese tenants. The cutworm is the chief insect enemy of potato culture.

SWEET POTATOES.

No fair estimate of the present production of the sweet potato has been made, but at one time in the history of the islands it received no little attention, as there are records telling of 50 varieties under cultivation. In 1850 the amount of sweet potatoes exported was 9,631 barrels.

It is a plant easily grown, thriving well on most parts of the islands where the rainfall is not too great. It is often seen growing around native huts in the dry and otherwise barren portions of the country, or over a coral bed where there may be but few inches of soil.

The sweet potato is propagated by cutting off the tops and planting them in a hill of dirt which is often merely the surface soil scraped together.

As an article of food, it is one of the principal vegetables and it is a deplorable fact that at the present time there is so little effort toward home production that large imports are being made, and the California sweet potato is seen in the Honolulu market as often as the home-grown product. The latter is sold at half the price of the former, the difference in price being in large measure due to inferior grading and packing for market of the home-grown article.

TARO.

The taro plant is used in making poi and as a vegetable. As it is generally cultivated as an aquatic, the sections chosen for its growth are near a water supply. The mountain streams are nearly all diverted during their course to the sea into the taro patches (rice and taro land may be used interchangeably), so the sections where taro is grown are the low plains or slopes of the valleys. (Pl. XXX, fig. 1.)

Cultivation.—The land is divided into patches varying from one-thirtieth to one-fourth of an acre. The patches are arranged in terraces separated by dykes, thus allowing the water to run from the upper to the next lower terrace.

The tops of the plants are cut when the crop is harvested, and these in turn are planted, and in time will make the new crop. It requires from ten to fifteen months for a crop to mature, the only work necessary during this period being to keep the patch well irrigated and free from weeds.

The growing of taro, although local, is an occupation of much importance to the islands. Extinction of this crop by other industries would be as great a hardship to the poorer classes of people as a wheat famine would be in the rest of the United States. While formerly taro growing was an industry confined entirely to the natives, it is gradually falling into the hands of the Chinese, and fully 50 per cent of the taro is now grown by Chinese, and 80 per cent of the poi is made by Chinese.

Taro lands rent for $40 to $50 per acre per annum. The yield per acre is from 6 to 10 tons. Taro sells at from 1½ to 5 cents per pound. One grower claims that 4 acres will yield a gross receipt of over $3,000.

The production of taro is roughly estimated to be worth about $100,000 to $150,000 per annum, and thus it will be seen that the industry is one of importance and must be fostered even to the sacrifice of some others.

The supply of taro is being cut down to no little extent by the taro disease, which causes a rotting of the tuber until often the whole plant becomes useless. This disease is undoubtedly encouraged by the depletion of the soil, as taro is grown year after year on land without fertilization. In some cases the loss has been 80 to 90 per cent of the yield, while the average loss is 50 per cent. Experiments are being carried on by the experiment station relative to this disease, and so far the results are encouraging.

The growing of taro need not be limited to small sections of irrigated lands, for there are varieties that thrive in the uplands where there is plenty of rainfall. This is called upland taro, and is less subject to disease than the lowland or water taro, and the poi made from it is of superior quality. (Pl. XXX, fig. 2.) The area of land adapted to its culture is very extensive, and the output from this land would exceed that of water taro many times.

There are about 40 varieties of taro; some are suitable for cooking as a vegetable, while others are better for poi. There is room for selection and improvement in the varieties of taro.

Poi is the staple food of the Hawaiians. It is made from the root of the taro, which is boiled, peeled, and mashed to a pulp. A little water is added until the consistency is that of paste.

The older white settlers find poi a palatable article of diet, and in this connection the food problem for our new tropical possessions might be considered. Poi is nutritious and in the partly fermented condition is very digestible, thus rendering it a good food for people living in the tropics, where stomach troubles among the white settlers seem to be very common.

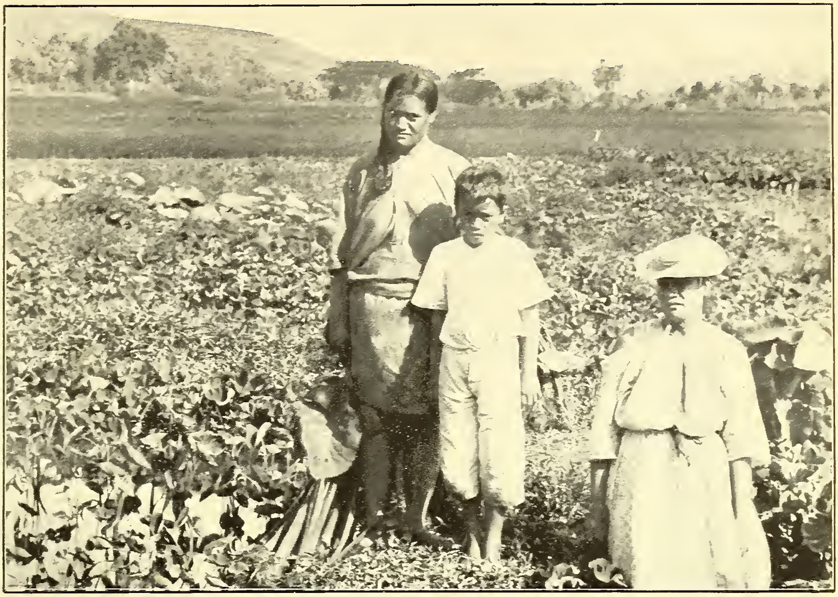


FIG. 1.—HAWAII STATION—WOMEN WORKING IN TARO FIELD.

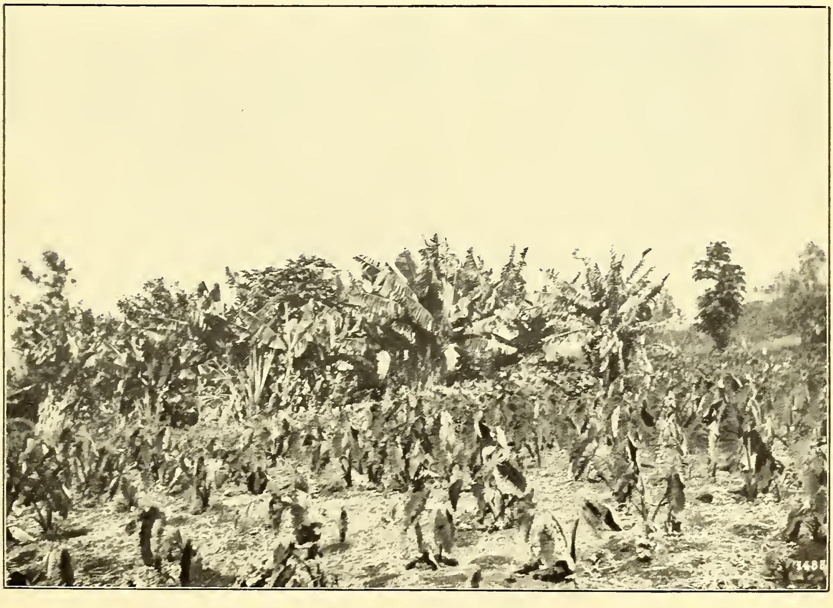


FIG. 2.—HAWAII STATION—UPLAND TARO AND BANANAS.

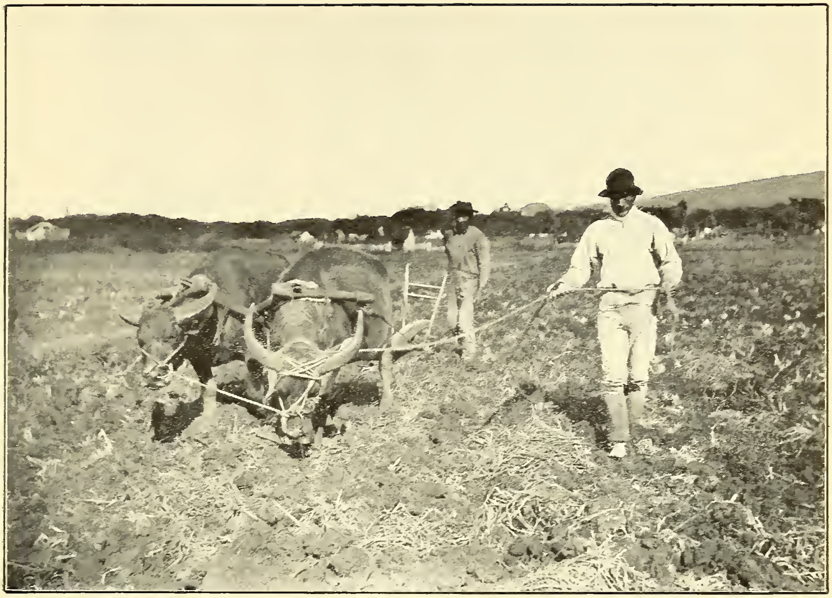


FIG. 1.—HAWAII STATION—PLOWING FOR RICE WITH WATER BUFFALO.

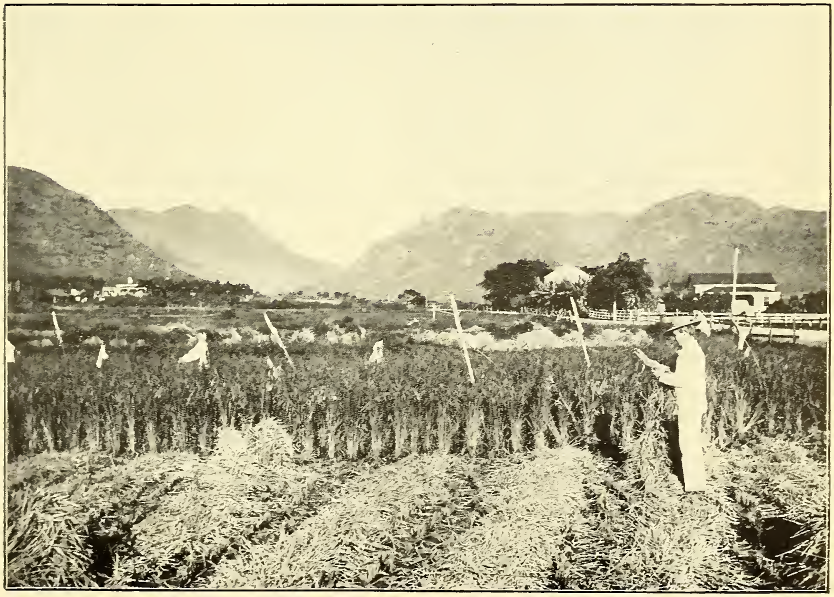


FIG. 2.—HAWAII STATION—HARVESTING RICE.

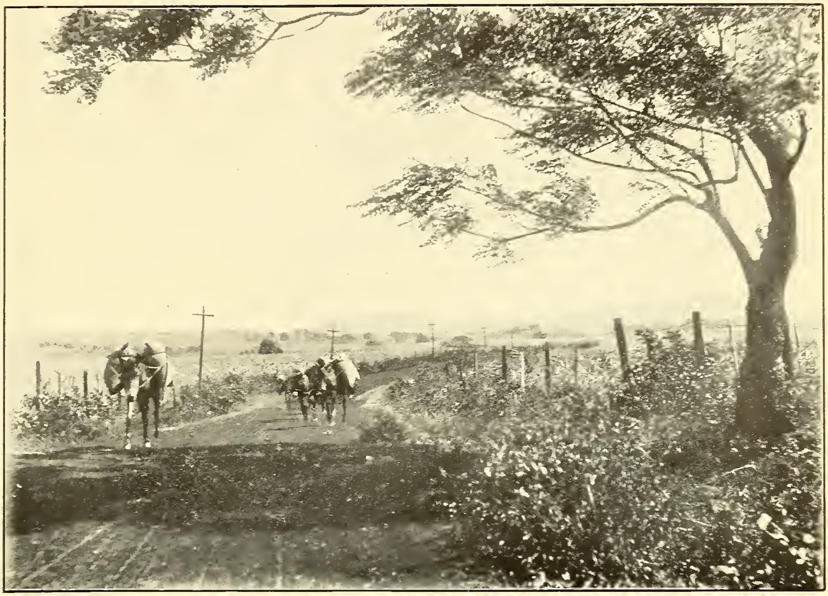


Fig. 1.—Hawaii Station—Marketing Rice.

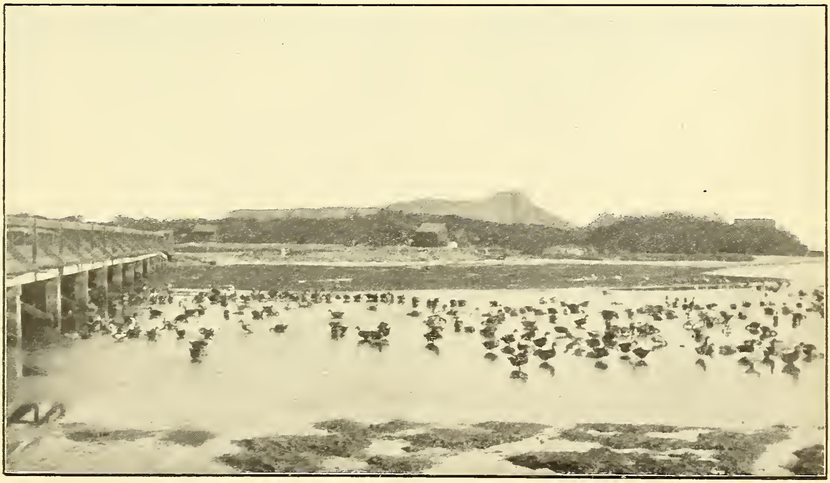


Fig. 2.—Hawaii Station—Duck Pond near Honolulu.

RICE.

Rice is grown almost exclusively by the Chinese. (Pl. XXXI, figs. 1 and 2.) Its preparation for market in many sections is very crude, the flail often being used to thrash the rice, while grading is done by hand sieves, and transportation is by means of pack mules or handcarts. (Pl. XXXII, fig. 1.) New methods and modern machinery, however, are being introduced.

The market price of rice ranges from 5 to 7 cents per pound. Rice lands rent for $40 to $60 per acre per annum. The production of rice is from 30 to 43 barrels per acre, or 5,000 to 7,000 pounds. As five crops can be grown on a given piece of land in three years, the average yield per acre per annum is 48 barrels, or 8,000 pounds. The area of rice land has decreased to some extent, owing to the introduction of sugar cane on the rice lands which were available for that purpose. At the present time rice is being imported for home consumption. The largest export of rice was during the year 1887, when 13,684,200 pounds were exported. Exports of rice have diminished to about one-fifteenth of that of 1887. The imports are upward of 250,000 pounds annually.

"KLU" BEAN, OR CASSIE.

The islands offer opportunities for the encouragement of some minor industries, such as spices, vegetable oils, and aromatic plants. Among the latter may be mentioned the Cassie flower. India furnishes much of this product, and in southern France there are plantations devoted to the cultivation of the Cassie flower. In Hawaii the plant grows luxuriantly and is found along the roadsides and in rocky and otherwise unproductive sections. Experiments have proved that the quality of the flowers after proper curing equals if not excels those produced in India. The price paid for Hawaiian-grown flowers is 60 cents per pound.

DUCKS.

Duck raising, which is entirely in the hands of the Chinese, has come to be an industry of some proportions, representing about $30,000 per annum. Ducks sell for $6 per dozen. The demand is so great that almost every available pond around Honolulu is utilized as a duck pond. The Chinese are remarkably successful in rearing the birds and keeping them free from disease. A Chinaman may have over 2,000 ducks in his flock, with only half an acre for ponds and runs. (Pl. XXXII, fig. 2.)

CHICKENS AND TURKEYS.

The raising of chickens is attended with many difficulties, among which are chicken pox, roup, and chicken cholera. The mongoose, also, is responsible for much of the trouble. Chickens flourish better in the higher localities. In earlier days chickens were apparently plentiful and sold for $3 per dozen, while now the market price is $15 per dozen, much of the local demand being supplied by imported fowls. The chicken industry, including eggs, amounts annually to $25,000 or more.

Turkey raising seems to be attended with the same difficulties as chickens. The price paid for dressed turkeys is about 30 cents per pound. In the mountains there are wild turkeys, or rather domesticated turkeys, which have found their way to the mountains and have reared broods. This seems evidence that turkeys might be raised under proper conditions and put on the market at reasonable prices.

SUGGESTED LINES OF INQUIRY.

The economic conditions of Hawaii are such that new industries can be established only with the greatest difficulty. In common with all other old insular regions there has been a multitude of serious insect and animal pests introduced, not through intent but as a concomitant of commerce. In this regard the history of Hawaiian agriculture is parallel with that of many other tropical islands, such as the Fiji Islands and the British West Indies. Plants may be introduced without their insect enemies, or insects which in their native country are kept in check by natural enemies, and parasites may here breed in enormous numbers and adapt themselves to new host plants, to the detriment of the farmer. Hawaii is full of ornamental exotics which have become weeds, and of Chinese, Japanese, Australian, American, and Old World insects which, free from all natural check, ravage alike the native vegetation and the cultivated crops. The lot of the farmer is thus in a way more difficult than in continental regions. The battle is a continuous one. The practical entomologist thus finds here a wider field for work, and although much has been done, a vast amount of work is yet to be accomplished. Some crops are abnormally free from blights and disease. Others fall a ready prey to hosts of enemies whose attacks the plants themselves are not prepared to resist nor do the farmers know how to combat. What is true of insect pests is also true of fungus and bacterial diseases. The field of investigation is a new one, hardly yet touched upon.

Lower world's prices for sugar means a narrowing of the margin of profit. With such a fall in prices and profits must come the substitution of more careful handling, better cultivation, conservation of the irrigation water (where used), and a more skillful fertilization of the soil. The Hawaiian sugar planters are prone to ignore these factors and to ascribe all of their benefits to cheap labor. If planters in other parts of the tropics can grow sugar at a profit in the open competition of the world's markets and in spite of the American duty on this product, there is still hope for greater reward in store for the Hawaiian grower. Investigations as to cultivation and the most efficient use of water would well repay. In this connection and as an aid to the future development of this island group a comprehensive soil survey of all the agricultural lands would save to the men who are to develop the resources of the land millions of dollars. Much experimental work has been done in trying to grow this or that crop. A soil map of the islands would, in case some one crop were found which grows better here than anywhere else, indicate exactly in what other regions this crop would be most likely to succeed. There is hardly a crop cultivated in all the subtropical regions of the globe but which has been grown here at some period during the past eighty years. Fruits, nuts, dyes, tannins, precious woods, spices, vegetables, drugs, fibers, and forage plants have been grown in endless variety. The castor-oil bean is grown in Kona and finds ready sale at $60 per ton. Tea is almost a weed in Olaa and Hamakua. Vanilla thrives in Kau, and the cocoanut in Puna. There are large trees of cacao, the source of chocolate, in the city of Hilo, and the African oil palm lines the streets of Honolulu. Tobacco of excellent quality has been grown on all the islands. The opportunities for work in lines where practical agricultural benefit will result are so many that it is difficult to choose what first to undertake.

Investigations in forestry are much to be desired, but these can not be undertaken by the station without considerable increase in its resources; and, in any case, whatever investigations the station might undertake in this direction should be done in cooperation with the Bureau of Forestry.

Many of the native woods of this group are extremely valuable from a commercial standpoint, and a considerable trade in these woods, notably koa and sandal, at one time flourished. It would be well if the entire backbone of each main mountain chain of each of the islands be set apart in forest reserves under the Federal Government, in order that the native forests may be protected and preserved and that a modern and legal system of forest conservation may be carried out. The sugar plantations all depend directly or indirectly on the wooded mountain slopes for their water supply, and it is due to their owners that something be done to check the further destruction of the native forests, and also to replant large areas with trees (native and foreign) which shall in the future become commercially valuable.

The station has already attained a sure footing in Hawaii. Many inquiries in regard to local problems in agriculture have been received and answered, and the interest in the station is constantly growing. If sufficient money can be appropriated to provide a suitable permanent equipment, results will the sooner be obtained.